UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/891,611 | 06/27/2001 | Mamoru Nakasuji | 010817 | 8874 |

38834 7590 05/18/2004

WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP
1250 CONNECTICUT AVENUE, NW
SUITE 700
WASHINGTON, DC 20036

| EXAMINER | |
|---|---|
| BERMAN, JACK I | |
| ART UNIT | PAPER NUMBER |
| 2881 | |

DATE MAILED: 05/18/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/891,611 | NAKASUJI ET AL. | |
| | Examiner | Art Unit | |
| | Jack I. Berman | 2881 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *06 February 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *105-149* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *105-149* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 October 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 136 and 138 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claims 136 and 138 use exactly the same language used in original claims 47 and 49. As was explained in the rejection of claims 47, 49, and 50 in the previous Office action, it is not clear how disposing the primary and secondary optical systems in two rows and in plural columns prevents a path of secondary charged particles deflected by one of the E x B separators from interfering with a path of the secondary charged particles deflected by the other E x B separator. The amendment filed on February 6, 2004 did nothing to clarify this issue. As was also explained in the previous Office action, the disclosure was so unclear that no comparison with the prior art could be made.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 113 and 115 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 113 depends from claim 1, which has been canceled. It is not clear which claim Claim 113 was intended to depend from. Claim 115 contains a limitation similar to that originally presented in Claim 11: "the primary optical system has a function of scanning the charged particle beams at a distance greater than the interval of irradiation of the

neighboring charged particle beams." The addition of the word "neighboring" does nothing to clarify the feature Applicant intended to claim. What is meant by "a distance greater than the interval of irradiation of the neighboring charged particle beams"? The language of this limitation is so garbled that it is not clear what subject matter is intended to be claimed. Therefore, the invention claimed could not be compared to the prior art. The lack of a rejection based upon prior art should not be construed as a determination that the claims contain allowable subject matter, only that the claims are incomprehensible.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 114, 132, 135, and 141 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,892,224 to Nakasuji. Nakasuji discloses an inspection method and

apparatus for irradiating electron beam to a sample to inspect the sample, comprising the steps of:

(a) irradiating a surface of the sample with a plurality of primary electron beams (EB11, EB21, EB31, ..., EB36) by a primary electronic optical system with an optical axis,

(b) converging secondary electrons generated from each of irradiating points of the a plurality of primary electron beams formed on the surface of the sample,

(c) leading converged secondary electrons toward to a detector by a secondary optical system with an optical axis,

(d) detecting the secondary electrons using a plurality of detectors (M11, M21, M31, ..., M36) so as to introduce them into an image processing system (processor 12) for forming an image by the secondary charged particles and a data processing system (memory 14) for displaying and/or storing a state information of the object to be inspected based on an output from the image processing system,

(e) repeating above steps (a) to (d) while transferring the sample successively (see lines 51-59 in column 16) and precisely positioning the beam on the object to be inspected by measuring a position of the object to be inspected (see lines 61-67 in column 14),

wherein the irradiating points of the primary electron beams are disposed in rows N in a direction of transferring the sample and in columns M in a direction perpendicular to the direction of transferring the sample (see Figures 2(b) and 7). At lines 36-41 in column 9, Nakasuji teaches that the positions at which the plurality of the charged particles are irradiated are separated enough that the secondary charged particles generated by each beam will only be incident on the detector designated for that beam, i.e. the separation of these positions is larger

than a distance resolution of the secondary optical system. At lines 38-41 in column 11, Nakasuji teaches to form the beam shaping apertures as ellipses in order to generate circular beams. This is the same technique disclosed on page 191 of the specification and Figures 41A and 41B of the instant application to correct field astigmatism and it inherently performs the same function.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 105 is rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 5,892,224 to Nakasuji. Nakasuji discloses an inspection apparatus for inspecting an object of inspection by irradiating the object of inspection with charged particles comprising:

a working chamber controllable into a vacuum atmosphere for inspecting an object of inspection (not labeled but inherently required because electron beam optical systems only work in a vacuum);

a beam source (1) for generating the charged particles or the electromagnetic wave as a plurality of beams (EB11, EB21, EB31, ..., EB36);

a primary electronic optical system for irradiating the plurality of beams to the object of inspection held in the working chamber, and a secondary electronic optical system for converging secondary charged particles generated from the object and leading to an image processing system (signal processor 12) which forms an image based on the secondary charged particles;

a data processing system (memory 14) for displaying and/or memorizing a state information of the object based on output of the image processing system; and

a stage system (28) for holding the object so as to be movable relative to the beam,

wherein an electric field for accelerating the charged particle beams is applied between a first stage lens of the secondary optical system and a surface of the object (lines 13-19 in column 9), and the secondary charged particles emitted from the surface of the object at an angle relative to a normal line of the surface of the object pass through the secondary optical system. While Nakasuji does not specifically teach to use secondary charged particles emitted at an angle of 45 degrees relative to the normal, the patent does teach at lines 23-41 in column 10 that the angle should be oblique and large enough to allow more space for detectors than is permitted by the space permitted when the primary beam irradiates the sample from a normal. Since angles of at least 45 degrees meet this criterion, such angles would be at least obvious over, if not inherently anticipated by, Nakasuji.

Claims 106-108 and 111 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakasuji in view of U.S. Patent No. 6,344,750 to Lo et al. Nakasuji does not teach how the

object under test is moved in or out of the (inherently required) working chamber, to isolate the object under test from vibrations, to apply a voltage to the object under test, how the object under test is held, or how the positioning of the object under test is determined. Lo et al. discloses scanning electron beam inspection apparatus similar to Nakasuji's and teaches at lines 53-60 in column 7 that transport mechanisms for securing an object under testing for transportation into and out of a testing chamber are conventional. It would have been obvious to a person having ordinary skill in the art to provide the Nakasuji apparatus with the conventional transport mechanism cited by Lo et al. At lines 48-53 in column 7, Lo et al. teaches to provide a vibration isolator (50) for preventing vibrations of the object under testing. It would have been obvious to a person having ordinary skill in the art to provide such a device in the Nakasuji apparatus because vibrations would be as detrimental to image resolution in the Nakasuji apparatus as they would be in the Lo et al. apparatus. At lines 4-20 in column 7 Lo et al. teaches to apply a voltage to the object (22) from a bias source (28) and to increase or decrease this voltage from zero to a predetermined value in order to either optimize voltage contrast or control the landing energy of the primary beam to prevent charge leakage through layers on the object under inspection. It would have been obvious to a person having ordinary skill in the art to apply this voltage to the sample in the Nakasuji system in order to have the same degree of control as in the Lo et al. apparatus. Lo et al. also teaches, at lines 38-44 in column 7 and lines 38-40 in column 8, that an alignment controller to control the position of the sample is needed and may comprise a laser interference type distance measuring unit (laser interferometer) for observing the surface of the object of inspection and providing feedback to determine the coordinates of the stage. It would have been obvious to a person having ordinary skill in the art to provide such an alignment

controller including a laser interferometer as the controller in the Nakasuji apparatus that Lo et al. teaches is required.

Claims 110 and 112 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakasuji and Lo et al. as applied to claims 106-108 and 111 above, and further in view of U.S. Patent No. 4,911,103 to Davis et al. While Lo et al. teaches a person having ordinary skill in the art to provide the Nakasuji apparatus with a conventional transport mechanism, including a loading chamber (loadlock subsystem 52), and to provide a vibration isolator (50) for preventing vibrations of the object under testing, neither Nakasuji nor Lo et al. discuss the problem of dust adhering to a wafer as the loading chamber is evacuated. Davis et al. discusses this problem at line 64 in column 10 through line 31 in column 11 and teaches that it occurs whenever wafers are transferred into a vacuum chamber through a loading chamber and further teaches to solve it by supplying a clean gas to the wafer. It would have been obvious to a person having ordinary skill in the art to apply Davis et al.'s solution to this problem, which would inherently occur in the Nakasuji/Lo et al. apparatus discussed above, by using Lo et al.'s loadlock subsystem as a mini-environment chamber for supplying a clean gas to said object under testing to prevent dust from attaching to said object under testing. Davis et al. also teaches, at lines 20-27 in column 23, that any number of load lock chambers and processing modules and transfer arms can be provided to deliver wafers between any two chambers in any sequence if desired. The provision of a plurality of loading chambers disposed between the mini-environment chamber discussed above and the testing chamber, each adapted to be independently controllable in a vacuum atmosphere, a first transport unit for transporting an object under testing between one of the loading chambers and the mini-environment chamber, and a second transport unit for transporting said object under

testing between one of said loading chambers and said testing chamber would therefore have been an obvious duplication of parts in accordance with Davis et al.'s suggestion. Davis et al. also teaches, at lines 42-61 in column 13, to perform a rough alignment of the object of inspection in the XY-directions and in the direction of rotation within the mini-environment space and it would have been obvious to a person having ordinary skill in the art to also include this function in the Nakasuji/Lo et al. apparatus discussed above for the same reasons discussed by Davis et al., i.e. quicker throughput.

Claims 114, 120-123, and 142 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,430,292 to Honjo et al. Honjo et al. discloses an inspection apparatus (2) for inspecting an object of inspection by irradiating the object of inspection with charged particles comprising: a working chamber controllable into a vacuum atmosphere for inspecting an object of inspection (not labeled but inherently required because electron beam optical systems only work in a vacuum); a beam generating means (21, 101, 311) for emitting the charged particles as a beam; a primary electronic optical system (25) wherein a plurality of beams (B) is guided to irradiate the object (S) of inspection held in the working chamber, and a secondary optical system (630, 631 in Fig. 37) leads secondary charged particles generated from the object to at least one detector (632) where they are detected and the detector output signals are led to an image processing system (355) which forms an image based on the secondary charged particles; a data processing system (356) for displaying and/or memorizing a state information of the object based on output of the image processing system; and a stage system (3)for holding the object so as to be movable relative to the beam. Honjo et al. also teaches throughout the patent that the apparatus is useful for detecting defects on wafers during or after a manufacturing

process. At lines 52-65 in column 27, Honjo et al. describes how the plurality of the charged particle beams are irradiated at positions separated by distance resolution of the secondary optical system. At lines 53-58 in column 9, Honjo et al. teaches that inspection, including the detection of secondary charged particles, occurs while transferring the sample. At lines 29-32 in the same column, Honjo et al. teaches that the points of irradiation by the primary charged beams to be formed on the surface of the sample may be arranged in two dimensional directions, i.e. in rows and columns. At line 63 in column 9 through line 21 in column 10, Honjo et al. teaches that the plurality of charged particle beams can be formed by directing a primary beam (B) through an aperture plate having a plurality of apertures adapted to form a plurality of charged particle beams, the beams being formed by containing particles generated by the beam generating means to form irradiation points disposed in rows N in a direction of transferring the sample and in columns M in a direction pérpendicular to the direction of transferring the sample, and the apertures are located within a range of a predetermined electron density of the charged particles emitted from the beam generating means.

Claims 109, 116-119, 124-131, 134, 140, and 143-147 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakasuji in view of U.S. Patent No. 4,954,705 to Brunner et al. While Nakasuji irradiates the sample with the primary beams at an oblique angle so as to provide separation between the primary beams and the secondary electrons emitted so that there is more room for detectors, Brunner et al. discloses an inspection apparatus wherein the electronic optical system comprises an objective lens (L2) and an E x B separator (WF), forms a plurality of beams to irradiate the object (see lines 14-22 and 37-48 in column 3), and includes an optical system for accelerating secondary charged particles emitted by irradiation of the beams

through the objective lens (see lines 48-51 in column 2), separating the particles by the E x B separator (see Figure 2), and projecting an image of secondary charged particles (see lines 51-62 in column 2), and a plurality of detectors for detecting the image of secondary charged particles (see lines 62-66 in column 2). (The Brunner et al device is also described in Section 3 of the article "Multi-Beam Concepts for Nanometer Devices" by Lischke et al., cited in the Information Disclosure Statement filed on January 18, 2002.) It would have been obvious to a person having ordinary skill in the art to use the electron-optical system disclosed by Brunner et al. to control the multiple electron beams used by Nakasuji when the Nakasuji apparatus is used to inspect semiconductors for defects since the Brunner et al. electron-optical system is designed specifically for this purpose. Since both Nakasuji and Brunner et al. teach that the plurality of charged particle beams may be formed by either providing a plurality of electron beam sources or an aperture plate that divides a single electron beam into a plurality of electron beams, the provision of both a plurality of electron sources and aperture plates that divide the electron beams from each of these electron sources into a larger plurality of beams would have been an obvious duplication of parts, as would the provision of a plurality of E x B separators as claimed in Claim 140 of the instant application. While Brunner et al. uses the same lenses for both the primary electrons and the secondary electrons, the patent explicitly teaches at lines 56-64 in column 3:

> "Further lenses can be provided in the described electron beam measuring instrument in order to achieve the necessary demagnification of the primary electron source or, respectively, magnification of the secondary particle source.
>
> Of course, it is also possible to separate the electron-optical beam paths of primary particles and secondary particles and to provide imaging elements for each beam path."

Nakasuji further teaches, at lines 13-62 in column 11, that when the plurality of electron beams are formed by means of an aperture plate between the electron source and the sample, the position of the single aperture plate in the direction of the optical axis should be disposed so as to minimize the difference in beam strength of the beams to be delivered from each aperture to the surface of the sample. At lines 41 in column 12 through line 41 in column 13, Nakasuji also teaches to provide a second multi-aperture plate with a plurality of apertures disposed in front of the detector wherein the positions of the apertures formed in the second multi-aperture plate are arranged so as to correct a distortion in the secondary optical system.

Claims 133, 137, 139, 148, and 149 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakasuji and Brunner et al. as applied to claims 109, 116-119, 124-131, 133, 134, 140, and 143-149 above, and further in view of U.S. Patent No. 6,614,026 to Adamec. Brunner et al. does not specify where the beam scanning means is in relation to the E x B separator (Wien filter), but Adamec teaches, at lines 1-4 in column 8, that such an E x B separator may be located within a deflector of the kind used for scanning so that the deflection field is superimposed upon the crossed electric and magnetic fields. Although the illustrations in the Adamec patent appear to suggest magnetic deflectors, no such limitation appears in the specification and since, as the disclosure discusses, both electric fields and magnetic fields cause deflection of electron beams passing through them, it would have been obvious to a person having ordinary skill in the art that an additional electric field could be superimposed on the crossed electric and magnetic fields as easily as a magnetic field for scanning purposes. The use of such superimposed fields to perform the scanning and separating functions required in the

Nakasuji/Brunner et al. apparatus discussed above would have been an obvious substitution of equivalent parts.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack I. Berman whose telephone number is (571) 272-2468. The examiner can normally be reached on M-F (8:30-6:00) with every second Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John R. Lee can be reached on (571) 272-2477. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jack I. Berman
Primary Examiner
Art Unit 2881

jb
5/14/04